ER 49 – Electrician Regulations Answer Schedule

Notes: 1. (1 mark) means that the preceding statement/answer earns 1 mark.

2. - This schedule sets out the expected answers to the examination questions. The marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.

3. - Symbols and terms - alternatives -

Power	W or P -
Voltage	V or E or U -
Phase	Active -

Question 1	*Marks*	*Reference*	*Marking notes*
(a) Any ONE of: ● The practising licence must specify the date of its expiry. ● The date of expiry must be no late than 5 years after the date of issue or renewal. ● The licence continues in force until the close of the date of its expiry.	(2 marks)	EA 104	
(b) ● Any ONE of: * It has a maximum operated time of more than 0.5 seconds at its rated residual current; or * It has a maximum operated time of more than 0.15 seconds at 5 times its rated residual current.	(1 mark)	ESR 24(4)(a)	
● It has a rated residual current exceeding 300 milliamperes.	(1 mark)	ESR 24(4)(b)	
(c) Any ONE of: ● Where a person is supplying electricity to the caravan. ● Where a person is hiring or leasing the caravan ● Before permitting or authorising a connection for the supply of electricity	(2 marks)	ESR 76 and 77	
(d) ● No.	(1 mark)		
● AS/NZS 3000: 2.3.2.2.1	(1 mark)		

Question 1	*Marks*	*Reference*	*Marking notes*
(e) ● Earth green/yellow. ● Neutral black or light blue ● Phases Any ONE of: * Any colour other than green, yellow, green/yellow, black or light blue. * Red, white or blue (dark blue)	(2 marks)	AS/NZS 3000 ~~3.8.1~~ Table 3.4 ***Figure 3.2***	
(f) (i) 6 times the cable diameter	(1 mark)	AS/NZS 3000 3.9.6(b)(i)	
(ii) 12 times the cable diameter	(1 mark)	AS/NZS 3000 3.9.6(b)(ii)	
(g) Any ONE of: ● Any plug intended to be used with the socket outlet can be conveniently inserted and withdrawn and not cause damage to any flexible cord or cable connected to the plug. ● Socket outlets shall not be installed where the withdrawal of a plug from the socket outlet is restricted by a permanent fixture or fitting within the installation.	(2 marks)	AS/NZS 3000 4.4.2.1	
(h) ● 16 mm^2	(1 mark)	AS/NZS 3000: Table 5.1	***No marks if aluminium is stated***
● Copper	(1 mark)	AS/NZS 3000: Table 5.1	
(i) Any ONE of: ● To minimize the risk associated with the occurrence of voltage differences between exposed conductive parts of electrical equipment and extraneous conductive parts	(2 marks)	AS/NZS 3000: 5.6.1	
● To bring exposed conductive parts or extraneous parts to the same or approximately the same potential.		AS/NZS 3000: 1.4.52	

Question 1			*Marks*	*Reference*	*Marking notes*
		• Bonding of extraneous conductive parts and their connection to the earthing system may be used to reduce the earth fault-loop impedance.		AS/NZS 3000 1.5.5.3(e)	
(j)	(i)	4 metres	(1 mark)	ECP 34 5.2.1	
	(ii)	1 metre	(1 mark)	ECP 34 Table 6	

Question 2	*Marks*	*Reference*	*Marking notes*
(a) (i) • The socket outlet must be not less than 0.3 metres from the floor	(½ mark)	AS/NZS 3000: 6.2.4.2	
• The socket outlet must be protected by an RCD	(1 mark)	AS/NZS 3000: 6.2.4.2(b)(iii)	
• The RCD must have maximum residual rated current of 30 mA	(1 mark)	AS/NZS 3000: 6.2.4.2(b)(iii)	
• The socket outlet must be enclosed in a cupboard during normal operation.	(1 mark)	AS/NZS 3000: 6.2.4.2(b)(iv)	
(ii) • The permanent connection unit must be not less than 0.3 metres from the floor	(½ mark)	AS/NZS 3000: 6.2.4.2	
• It must have a rating of IPX4	(1 mark)	AS/NZS 3000: 6.2.4.3	
(b) Additional protection by RCDs as required by Clause 2.6 shall be provided for the final subcircuits supplied from that switchboard.	(2 marks)	AS/NZS 3000 2.6.3.4	
(c) Any THREE of:	(3 marks)		
• On failure of the supply it does not automatically open		ESR 24(2)(a)	Portable RCDs
• On failure of the supply it does not continue to provide protection		ESR 24(2)(b)	Portable RCDs
• If it has a rated residual current exceeding 30 milliamperes		ESR 24(3)	Portable RCDs
• It does not interrupt the current in all live conductors within 300 milliseconds when passing its rated residual current		ESR 24(3)(a)(i)	Portable RCDs
• It does not interrupt the current in all live conductors within 40 milliseconds when passing 5 times its rated residual current		ESR 24(3)(a)(ii)	Portable RCDs
• It interrupts the current in all live conductors when passing leakage current at or below half its rated residual current		ESR 24(3)(b)	Portable RCDs

Question 2	*Marks*	*Reference*	*Marking notes*
- It does not meet the limits specified AS/NZS 3190 - It has a maximum operating time of more than 0.5 seconds at its rated residual current. - It has a maximum operating time of more than 0.15 seconds at 5 times its rated residual current. - It has a rated residual current exceeding 300 milliamperes		ESR 24(3)(c) ESR 24(4)(a)(i) ESR 24(4)(a)(ii) ESR 24(4)(b)	Portable RCDs Property RCDs Property RCDs Property RCDs

Question 3	*Marks*	*Reference*	*Marking notes*
(a) (i) The switchboard	(1 mark)	AS/NZS 3000 2.5.3.3(a) Figure 2.3	
(ii) Short-circuit current	(1 mark)		
(iii) The motor starter	(1 mark)	AS/NZS 3000 2.5.3.3(a) Figure 2.3	
(iv) An overload	(1 mark)		
(b) ● The isolating switch shall have a rating of not less than the full load current of the motor.	(1 mark)	AS/NZS 3000: 4.13.1.2	
● The isolating switch shall be capable of interrupting the locked rotor or stall current of the motor.	(1 mark)	AS/NZS 3000: 4.13.1.2	
(c) Any TWO of:	(4 marks)		
● Supplied as an SELV or PELV system in accordance with Clause 7.5		AS/NZS 3000: 6.3.4.5(c)(i)	
● Supplied individually as a separated circuit, in accordance with Clause 7.4		AS/NZS 3000: 6.3.4.5(c)(ii)	
● Of Class II construction (double or reinforced insulation).		AS/NZS 3000: 6.3.4.5(c)(iii)	
● Of Class I construction (earthed conductive parts) and supplied from a circuit protected by an RCD with a fixed rated residual current not exceeding 30mA		AS/NZS 3000: 6.3.4.5(c)(iv)	
● It has a degree of protection of IPX4		AS/NZS 3000: 6.3.4.1(c)	

Question 4	*Marks*	*Reference*	*Marking notes*
(a) • Insulation • Obstacles	(2 marks)	AS/NZS 3000: 1.5.4.2(a), (c)	
(b) • A key or tool is required. • An interlocking device is fitted • An intermediate barrier is provided	(1½ marks)	AS/NZS 3000 1.5.4.4(b)(i), (ii), (iii)	
(c) (i) Any ONE of: • International Protection • A degree of protection in accordance with AS 60529.	(1 mark)	AS/NZS 3000: 1.4.61	
(ii) • Full penetration of 12.5 mm sphere not allowed.	(1 mark)	AS/NZS 3000 Figure G1a	
• The jointed test finger shall have adequate clearance form hazardous parts.	(1 mark)	AS/NZS 3000 Figure G1a	
(iii) • Protected against water splashed from all directions	(1 mark)	AS/NZS 3000 Figure G1b	
• Limited ingress permitted	(1 mark)	AS/NZS 3000 Figure G1b	
(d) • Access is restricted to competent persons • Access is restricted to persons under the supervision of a competent person. • Simultaneous accessible parts at different voltages shall not be within arms reach • Simultaneous accessible parts are more than 2.5 m apart	(1½ marks)	AS/NZS 3000 1.5.4.6 Figure 1.1	

Question 5			*Marks*	*Reference*	*Marking notes*
(a)	(i)	A Type I RCD	(½ mark)	AS/NZS 3003 2.8.1	
	(ii)	• Has a maximum rated residual current not exceeding 10 mA.	(1 mark)	AS/NZS 3003 2.8.1	AS/NZS 3000: 2.6.3.3(b) has the same provision
		• Has a maximum tripping time not exceeding 40 ms.	(1 mark)	AS/NZS 3003 2.8.1	
	(iii)	Any ONE of: • It shall switch all live conductors. • It shall switch both poles	(1 mark)	AS/NZS 3003 2.8.3	
(b)	(i)	• Shall be marked "dialysis machine only" and "RCD protected"	(1 mark)	AS/NZS 3003 5.2.1(a)	
		• It shall be supplied by a dedicated circuit. The circuit shall not be used to supply any other socket outlets or electrical equipment.	(2 marks)	AS/NZS 3003 5.2.1(c)	AS/NZS 3000: 2.6.3.3(a) has the same provision
		• The LPD shall be positioned so that it can be reset by the patient while under treatment	(1 mark)	AS/NZS 3003 5.2.1(d)	AS/NZS 3000: 2.6.3.3(b) has the same provision
		• The socket outlet must incorporate a power-available indicator light.	(1 mark)	AS/NZS 3003 5.2.1(f)	
	(ii)	• It shall be protected by an RCD having a rated residual current not exceeding 30 mA.	(1 mark)	AS/NZS 3003 5.2.1(e)	
		• Installed in accordance with AS/NZS 3000.	(½ mark)	AS/NZS 3003 5.2.1(e)	

Question 6	*Marks*	*Reference*	*Marking notes*
(a) • The parts of the installation is electrically safe	(1 mark)	ESR 13(1)(a)	
• The work has not adversely affected the electrical safety of the rest of the installation.	(1 mark)	ESR 13(1)(b)	
• Must ensure the fittings or appliances are electrically safe	(1 mark)	ESR 13(2)	
• While doing the work take all practicable steps to ensure that people and property are protected from dangers arising from the work.	(1 mark)	ESR 13(3)	
(b) (i) AS/NZS 3000	(1 mark)	ESR 65 (1)	
(ii) Testing the insulation resistance between live conductors and earth.	(1 mark)	AS/NZS 3000 8.3.6.1	
(iii) • Testing the insulation resistance between live conductors and earth.	(½ mark)	AS/NZS 3000 8.3.6.1	
• Testing the insulation resistance between live conductors	(½ mark)	AS/NZS 3000 8.3.6.1	
(iv) A value in excess of 50 MΩ would be expected	(1 mark)	AS/NZS 3000 8.3.6.2 Note	
(c) Any TWO of:	(2 marks)		
• That particular tests have been satisfactorily completed.		ESR 67(2)(b)	
• That the rating of the earthing system for the installation is correct		ESR 67(2)(c)	
• That particular fittings on which work has been done are safe to connect to the power supply.		ESR 67(2)(d)	
• That particular parts of the installation are safe to connect to the power supply		ESR 67(2)(e) ESR 67(1)(a)	

Question 7	*Marks*	*Reference*	*Marking notes*
(a) Any ONE of: ● Use of appliances that are supplied from an extra-low voltage source ● Use of low voltage double insulated appliances protected by an RCD. ● Use of low voltage fixed wired appliances supplied from an isolating transformer	(2 marks)	ER 89(1)(b)	The introduction states that both low voltage and extra-low voltage appliances are available
(b) Any FOUR of:	(4 marks)		
● The appliance is fixed wired and connected through a continuous flexible cord to a supply of electricity from a source isolated from earth with a voltage between conductors not exceeding 250 volts.		ESR 89(1)(a) ESR 89(2)(a)	As the introduction states that both low voltage and extra-low voltage appliances are available any option from ESR 89(1) and (2) is correct
● Supplied with electricity from an extra-low voltage source		ESR 89(1)(b) ESR 89(2)(b)	
● The appliance is double insulated and is supplied with electricity through a RCD that provides protection against electric shock		ESR 89(1)(c)	
● The appliance is supplied with electricity from a monitored earth circuit where the supply to the appliance is automatically interrupted if the earth to the appliance being broken or detached.		ESR 89(2)(c)	
● The appliance is supplied with electricity from a source connected to earth so that the voltage to earth will not be greater than 55 volts a.c:		ESR 89(2)(d)	
● The appliance is supplied with electricity through a RCD that provides protection against electric shock.		ESR 89(2)(e)	
● The appliance is supplied with electricity from a source isolated from earth with a voltage between conductors not exceeding 250 volts		ESR 89(2)(f)	
● The appliance is double insulated:		ESR 89(2)(g)	

Question 7	*Marks*	*Reference*	*Marking notes*
(c) Any TWO of:	(4 marks)		As (c) specifies Class I appliances only bullet points 1, 2, 4, 5, 6, and 7 from (b) are relevant
• The appliance is operating on an isolated supply which has no reference to earth hence no potential to earth.			(b) - 1st bullet point
• The appliance is operating at a voltage such that the touch voltage cannot rise to dangerous levels under fault conditions.			(b) – 2nd bullet point
• The earth wire continuity is continuously being monitored and will disconnect the appliance when the earth fails.			(b) – 4th bullet point
• The touch voltage on any appliance cannot rise above 55 volts, which is close to a safe touch voltage.			(b) – 5th bullet point
• The earth leakage current is continuously being monitored by RCD and will disconnect the appliance when earth leakage rises above a pre-determined level.			(b) – 6th bullet point
• The appliance is operating on an isolated supply which has no reference to earth hence no potential to earth.			(b) – 7th bullet point

Question 8		*Marks*	*Reference*	*Marking notes*
(a)	Any TWO of: - Installed in a section of the cupboard from other sections. - Installed at the front of the switchboard section of the cupboard. - Installed facing the cupboard door - Arranged so there are no projections that obstruct access.	(2 marks)	AS/NZS 3000 2.9.2.5(c)	
(b)	Any ONE of: - Live parts shall be arranged so that protection against direct contact is provided by barriers or enclosures in accordance with the provisions of Clause 1.5.4.4 - Live parts may be exposed provided that the switchboard is installed in an area which is accessible only to authorized persons and the means of access to such areas is provided with facilities for locking.	(2 marks)	AS/NZS 3000: 2.9.3.1	
(c)	Any TWO of: - The location of the main switchboard shall be legibly and permanently indicated by a conspicuous notice at each entry to the building that may be used by emergency services personnel. - The location is clearly indicated on the Fire Indicator panel. - The location of the switchboard is clearly visible from the main entrance to the electrical installation.	(2 marks)	AS/NZS 3000 2.9.2.4	
(d)	- The minimum width of the doorway is 0.75m - AS/NZS 3000:2.9.2.2(c)(iii)	(1 mark) (1 mark)		
(e)	- 0.6m clear space with the switchboard doors open. - AS/NZS 3000: 2.9.2.2(a)(i)	(1 mark) (1 mark)		

Question 9 | *Marks* | *Reference* | *Marking notes*

(a)

Equipment	**Load Group**	**Calculation**	**Load (Amps)**	
32 - lighting points	A		6	(½ mark)
4 – 10A double socket outlets	B		15	(1 mark)
10 – 10A single socket outlets	B			
1 – 2.5 kW electric oven	C		15	(½ mark)
1 – 2 kW storage water heater	F		6	(½ mark)
1 – 4 kW air conditioner unit	D	4000 ÷ 230 x 0.75	13.04	(1 mark)
Total Maximum Demand			**55.04**	(1½ marks)

AS/NZS 3000: Table C1, column 3

(b)

Solution 1 – Copper cable

Maximum demand / phase	(½ mark)		
= 55.04 x 4			
= 220.16A	(1 mark)		
From Table 13, column 23 the rating for 70 mm^2 copper cable is 241A.	(½ mark)		
From Table 27(2), the de-rating factor for 20^0C is 0.95	(½ mark)		
The maximum load can be carried by the 70 mm^2 cable is:	(½ mark)		
= 241 x 0.95			
= 228.95	(1 mark)		
A 70 mm^2 copper cable can supply the load	(1 mark)		

Solution 2 – Aluminium cable -

Maximum demand / phase	(½ mark)		
= 55.04 x 4			
= 220.16A	(1 mark)		
From Table 13, column 24 the rating for 120 mm^2 copper cable is 256A.	(½ mark)		
From Table 27(2), the de-rating factor for 20^0C is 0.95	(½ mark)		
The maximum load can be carried by the 120 mm^2 cable is:	(½ mark)		
= 256 x 0.95			
= 243.2	(1 mark)		
A 120 mm^2 aluminium cable can supply the load	(1 mark)		